THE SHRIMPS OF TROPICAL SEAS

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In comparison with their relatives in temperate waters the shrimps of tropical seas have received comparatively little scientific study. This applies particularly to the northern shores of Australia. The larger species of commercial importance, the prawns, or members of the infraorder Penaeidea (Fig. 1a), are moderately well known, but the much larger number of smaller species of the infraorder Caridea (Fig. 1b), generally referred to as shrimps, have been almost entirely neglected. At present it is not possible even to guess how many kinds may occur in coastal waters of the Northern Territory but probably some 250-300 different species may well be present. A preliminary search of the literature has indicated only some 17 species. Most of the common and well known tropical species, such as *Conchodytes meleagrinae*, which occurs in pairs in pearl oysters, have not yet been formally recorded from this region, although it is virtually certain to be common in suitable waters where pearl oysters occur.

Shrimps are members of the crustacean order Decapoda, which also includes prawns, hermit-crabs, lobsters and crabs. All these are typically provided with five pairs of walking legs, some of which generally end in nippers. The "prawns" have the first three pairs of legs provided with small nippers and their eggs are cast loose into the sea. This is in contrast with the "shrimps", which do not have more than the first two pairs of legs with nippers, and whose eggs are carried attached beneath the abdomen of the female during development. The terms "prawns" and "shrimps" are used in quite a different sense in European waters and refer to species that do not occur in tropical waters.

The Classification of Common Tropical Shrimps

There are numerous families of shrimps that occur in tropical seas. Unfortunately these have not acquired any consistently used popular names in English. In shallow waters, the fauna is dominated by three families in particular. The two families of major importance are the families Alpheidae, (the snapping or pistol shrimps), and the Palaemonidae, as represented by the subfamily Pontoniinae. Palaemonid shrimps are common in shallow temperate waters where they are called "prawns". They are also conspicuous in tropical fresh waters but are rare in marine habitats, except for the numerous members of the specialized subfamily Pontoniinae. Of lesser importance is the family Hippolytidae. Numerous other families such as the Pasiphaeidae, Rhynchocinetidae, Processidae, Pandalidae and Crangonidae, are also represented each by a few species. One species of the latter family is the traditional "shrimp" of north-west European waters.

The alpheid shrimps (Fig. 2a), may generally be recognized by the presence of a well developed pair of nippers, or chelae, on the first pair of walking legs. These chelae are often very unequal or asymmetrical and one may be modified with a "pit and hammer" sound-producing mechanism. In many species a hood extends over the eyes, protecting them and obscuring them from view. The second pair of legs is very slender in comparison, similar to each other, highly flexible and armed with only tiny chelae.

The pontoniine shrimps (Fig. 2b) have the first pair of legs, slender and symmetrical, with only small chelae, whereas the second pair of legs is much more strongly developed and with large chelae, which may be similar and equal on each side of the body, or dissimilar and unequal. They have no popular name.

Hippolytid shrimps (Fig. 2c), many of which are often known as "grass shrimps" usually have only inconspicuous chelae on the first and second pairs of walking legs. The first pair is short and robust, whereas the second pair is elongated and slender, frequently with many segments and highly mobile, much as in the alpheid shrimps. However, occasional specimens do occur with large nippers as an abnormality.

General Biology

Most shrimps are rarely seen by day, even in shallow water. Many of the species are free-living but nocturnally active. By day they inhabit temporary burrows on the sea bed, or in permanent excavated burrows or other nooks and crannies. Others hide in holes in rocks or caves in reefs while several live amongst dense seaweeds, which they usually closely resemble in colour. Others are not free-living but live in a permanent association with some other marine animal. These are frequently referred to as "commensals" on the assumption that they do no harm to their host and are not therefore predators or parasites. The host animal therefore offers protection and possibly a source of nutrition, and many receive some benefit from its guest.

Many of these tropical shrimps are of very small size and so easily escape detection. *Fennera chacei*, which lives on certain branching corals, is adult when only about 5mm long. The general size range is only about 15-25mm although a number of species do reach about 80mm. Many species, both free-living and commensal, are cryptically coloured, and blend well into their appropriate habitats. Others can achieve invisibility by being almost transparent, or with only a few small flecks of colour. Almost all dislike exposure to light and take the first opportunity to hide themselves when disturbed, either by burrowing into the substrata or by shooting backwards into some small dark niche.

Reproductive Biology

Almost all of the tropical shrimps have eggs that hatch into a small larval stage that is quite unlike the adult. These are planktonic for an unknown period, during which they are transported by the local currents. During this planktonic phase the larvae grows and undergoes a series of moults and finally turns into a miniature shrimp. At this stage it ceases to be planktonic and settles on the sea floor to commence its adult life style. For the commensal species, this change is critical as they must locate an example of their appropriate host animal to have any prospect of survival. It appears inevitable that vast numbers must fail in this search. The host is probably located at short range by chemo-sensory means and once the juvenile has settled on its host it is unlikely that it will ever leave it again under normal circumstances.

Commensalism

Commensal shrimps are found in the three families Alpheidae, Palaemonidae and Hippolytidae and the phenomenon is characteristic of shallow tropical seas. It is rare in colder waters and there is little evidence of its extensive occurrence in deep seas, although some examples are known. The types of animals that act as host are of great diversity. Of particular importance are numerous sponges, many reef corals, sea ferns and whips, hydroids, anemones and even jelly fish. Many types of echinoderm may act as host; sea stars, urchins, cucumbers, feather stars and brittle stars may all have shrimps associated with them, as may many of the larger bivalve molluscs, such

as giant clams, oysters, pearl shells, scallops, fanshells and others. Many sea squirts also contain commensal shrimps. Others may be associated with fish, either living together in a shared burrow, or in a "cleaner" relationship where the free-living shrimp is reputed to remove parasites from passing fishes, which are attracted to its station by its behaviour and colour pattern.

Very little is known of the biology of these commensal species. The associations are generally very highly specific and in many cases the shrimp guest closely matches the colour patterns of the host animal so that it can only be discerned with difficulty. In fact, many have been found more by accident than design. This applies especially to the species that live inside clams or sea squirts, as the host animal has to be cut up to find them. In these cases, the shrimps are nearly always present as a male-female pair. In sponges and the various coelenterates, many of which can reach a considerable size, many individuals of several species or even genera may often be found. As yet there is no information on the growth rates or longevity of these shrimps and very little is known about their feeding habits. Some of the free-living species are undoubtedly micro-predators, feeding on still smaller crustacea or worms. It appears probable that some of the commensal species may be mucus feeders. Mucus is now known to be a rich food source and is produced in large quantities by many of the animals that are utilized as hosts. Other species may be cleaners. The alpheid shrimp *Aretopsis amabilis* lives in pairs in safe gastropod shells occupied by large hermit crabs, where it may be a faecal feeder, thereby cleaning the inside of the shell. Others may feed on the tissues of the host animal, thus being predators or parasites. Some of the species of the pontoniine genera found in association with sea anemones have been found to have stinging cells derived from their hosts in their stomach contents. A few species may be specialized plankton feeders. As yet there is very little precise information on their feeding relationships.

One of the most interesting aspects of the biology of tropical commensal species is the specialized adaptations that they show to their ecological niches. The pontoniine shrimps of the genera *Stegopontonia* and *Tuleariocaris*, that live on the long slender spines of some sea urchins, are remarkable for the very slender elongated form of the body, and feeble development of their walking legs. In contrast, the shrimp *Paratypton siebenrocki*, has an adult female that can only be described as globular. This shrimp occupies, with its smaller mate, a small rounded cyst-like cavity in the skeleton of some stagshorn coral. It is probably not really as rare as the few records of its occurrence suggest, it is just that it is very rarely found. Also found in corals, the alpheid shrimp *Racilius compressus* shows remarkable compression of its body from side to side, enabling it to move freely in the narrow spaces between the coral branches. In contrast, in the same coral host the pontoniine shrimp *Platycaris latirostris*, a sluggish form, is flattened from back to front. Many species have the claws at the ends of their legs modified, presumably to provide a better grip on their hosts, and some species have the tail fan also provided with hooks. Most species do not need the large nippers for holding onto their host and these seem to be used mostly in attack or defence. Some are capable of giving a sharp nip despite their small size. The alpheid genera *Synalpheus* and *Alpheus* and the pontoniine genera *Periclimenaeus* and *Coralliocaris* contain species that are capable of sound production, and the species of *Alpheus* are responsible for a lot of underwater noise on coral reefs, but the function of these sounds, if any, is unknown. Except in the genus *Coralliocaris*, only one of the large nippers is modified for sound production and these chelae are often greatly enlarged, almost equal to the size of the body of the shrimp.

Collecting Methods

Shrimps may be collected by a variety of methods. Some can be found under stones or small rocks on intertidal beaches and others are found in shore pools. The use of small hand nets amongst shallow water algae often produces an unexpected variety of small shrimps as well as other crustaceans. A fine-meshed hand held net, when swept through seaweeds, the tentacles of an anemone, the branches of a gorgonian or the fronds of a soft coral, will often reveal the presence of associated shrimps. For this purpose a net with a small transparent container at its apex is often most convenient. The shrimps caught, which may be small and transparent, swim downwards into the container and are more easily seen. In deeper waters, specimens are often obtained from trawl, dredge or grab catches. Undoubtedly the method that has produced most information over recent years is hand collection by snorkel or scuba-divers. Here the methods are precise and the exact depth, habitat or host are known. Shrimps can be chased and caught with hand nets or guided into small polythene bags. In addition, suitable host animals can be sampled and brought up in polythene bags for detailed examination. This method is especially suitable for large sponges or corals, which have to be broken up to extract the associated shrimps. Most species are quite delicate and easily damaged and so are best gently handled by means of fine forceps. Some host specimens are best brought up from the sea bed in dust-bins! Divers operating at night have frequently been surprised by the abundance and variety of shrimps, especially on coral reefs. When caught for scientific study, shrimps can be preserved in 8% formaldehyde solution or 70% spirit. The latter unfortunately rapidly destroys the attractive colour patterns that many species possess while formaldehyde destroys the colour pattern more slowly.

Generally it is best to allow the shrimps to die before placing them in preserving fluid, as the sudden shock of preservation will often cause them to shed their legs. Their death can be expedited by refrigeration on ice or by overheating from sunlight. Often it is necessary to put them in a small plastic jar or tube with some fragments of seaweed or other material, as they often tend to attack one another with vigour when in a confined space. Interesting specimens are best placed in separate tubes or small plastic jars so that no damage to them occurs. It is generally necessary to have intact specimens in order to establish their identity. With the alpheid shrimps, it is often necessary to have both male and female specimens, as the chelae may differ in the two sexes.

All specimens should be carefully labelled with details of locality, habitat, host, depth and means of collection, date, and name of the collector. A note of the colour pattern is often a useful addition, and, for the commensal species, the host or at least a portion of it, should also be preserved for specialist identification. Waterproof ink on good quality paper is best for specimen labels and should be placed in the containers with the preserved animals.

Zoogeography

Most of these tropical shrimps occur throughout vast areas of sea. Although the distributions of many of the less common species are not yet accurately known, it is clear that many extend from the northern Red Sea to the Tuamotu Islands, i.e., throughout the whole Indo-West Pacific faunal region. This pattern must be facilitated by the distribution of the planktonic larvae by ocean currents. Some of the Indo-West Pacific species have succeeded in crossing the East Pacific Ocean Barrier and successfully colonized the tropical western American seaboard. It is noteworthy that a particularly large proportion of these are species of commensal habits. A few species are known to be circumtropical.

Conclusions

The first step in any study of the marine fauna is to determine what species of animal occur, then to identify its habitat, distribution and assess its abundance, followed by more detailed studies on their biology. Much of the collecting necessary for this work can be readily carried out by interested amateurs, who, in this part of the world, stand almost as much chance of finding something exciting or new as the professional zoologist. Many of the free-living species survive well in aquaria if isolated from potential predators. Some of the commensal species can also be kept, if the host animal can be kept under aquarium conditions, such as the shrimps from sea anemones or starfish. Anyone finding crustaceans of interest, or from unusual or rarely visited localities, is most welcome to bring them to the Division of Natural Sciences of the Northern Territory Museum.

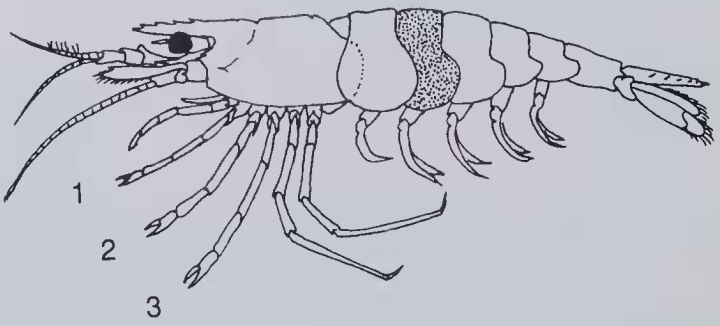

Figure 1a: Diagrammatic penaeid prawns, showing chelate pereiopods 1-3 and first abdominal segment posteriorly overlapping the second (shaded).

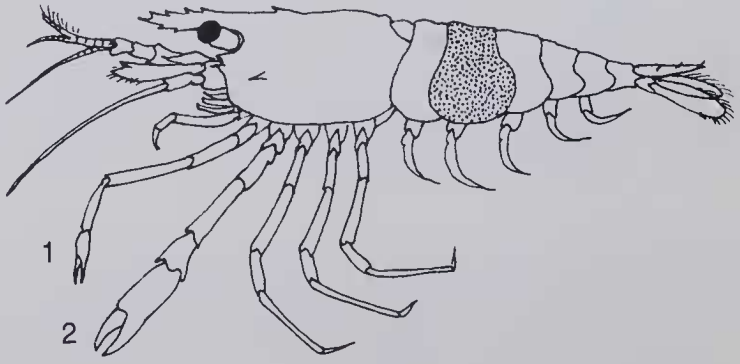

Figure 1b: Diagrammatic caridean shrimp, showing chelate pereiopods 1-2 and second abdominal segment (shaded) overlapping first anteriorly.

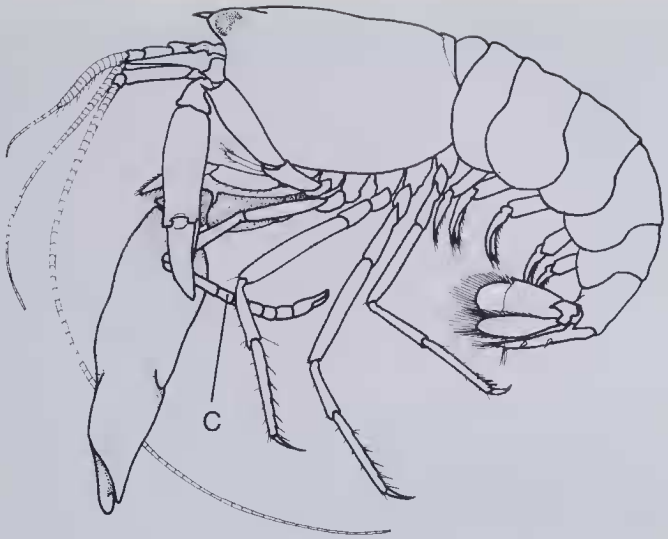

Figure 2a: Alpheid shrimps — First pair of pereiopods very robust, usually markedly unequal; second pair slender, carpus multi-segmented (c); eyes usually hooded by carapace; rostrum short, unarmed.

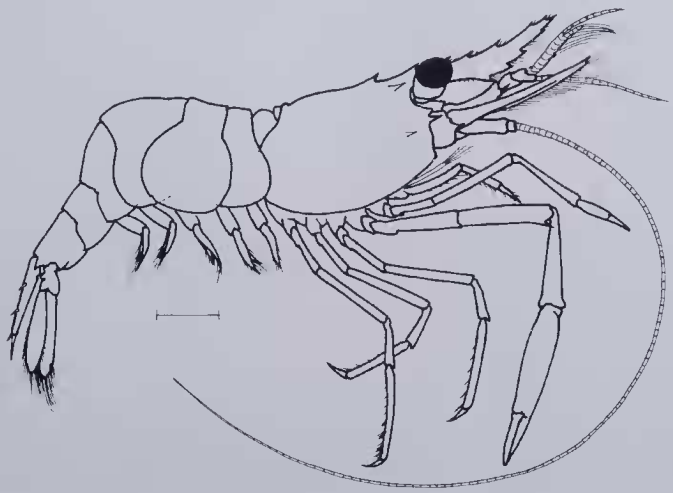

Figure 2b: Palaemonid shrimps — First pair of pereiopods slender; second pair robust, generally subequal; rostrum well developed, often dentate; eyes not concealed.

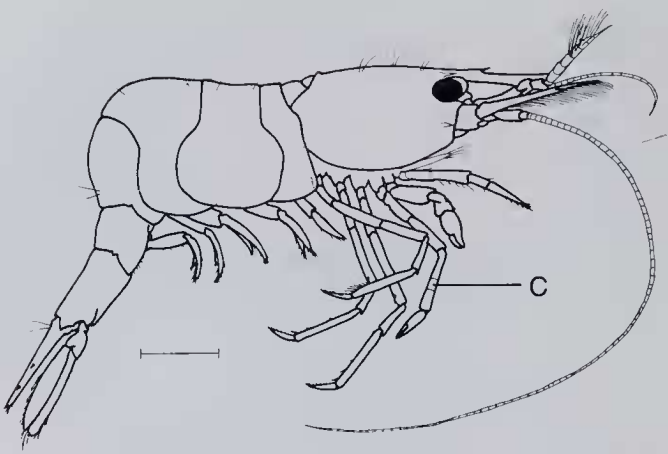

Figure 2c: Hippolytid shrimps — First pair of pereiopods generally small and robust; second pair slender, carpus multi-segmented (c); eyes not concealed.

Leandrites *sp., a palaemonine shrimp that behaves as a fish cleaner. It occurs in Darwin Harbour, where its yellow markings make it conspicuous.*

Thor amboinensis *(left), hippolytid shrimps and* Periclimenes brevicarpalis *(right), a pontoniine shrimp that may be commonly found together on giant anemones.*

Thorella cobourgi, *a minute hippolytid shrimp, about 5mm in length, first discovered in the Northern Territory amongst shallow water algae.*

Chernocaris placunae, *a pontoniine shrimp about 20mm long, that lives in male-female pairs inside window-pane clams (*Placuna *sp.).*

N.T. Museum curator making collections of soft corals for their associated shrimps.